TB MED 159

WAR DEPARTMENT TECHNICAL BULLETIN

AMEBIASIS

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1. GENERAL. Amebiasis is infection with *Endamoeba histolytica.* It is primarily an intestinal infection with its principal localization in the large intestine. Other parts of the body, however, are not infrequently involved. There is no clear evidence of any natural immunity, although many individuals who harbor this parasite apparently are asymptomatic. Amebiasis has a wide geographic distribution, being found sporadically in most parts of the world. It is especially common in areas with warm and hot climates, where it may have more or less constantly high incidence. Localized epidemics may occur in any region. Estimates of the incidence of infection with *Endamoeba histolytica* in the United States vary from 5 to 20 percent.

2. ETIOLOGIC AGENT. *Endamoeba histolytica* is a rhizopod protozoon. At least four other species of amebae also inhabit the human intestine, but none of these is known to cause lesions. *Endamoeba histolytica* has been found naturally occurring in monkeys and perhaps other animals, in addition to man. A number of animals, especially kittens, are susceptible to artificial infection. Strains of the organism vary in virulence, but neither the size of cyst associated with the strain nor any other criterion is considered a reliable means of differentiation. The life cycle of *Endamoeba histolytica* includes trophozoite, precystic, and cystic stages. As far as is known, only the cystic stage persists free in nature. Trophozoites and precystic forms rapidly disintegrate after passage from the intestine, which in general occurs only in association with diarrhea. Although it has been shown that under artificial conditions, trophozoites may pass through the stomach, natural infection occurs only through the ingestion of cysts. When cysts reach the region of the ileocecal valve, excystation occurs, resulting in free trophozoites which may attack the tissues. Trophozoites appear to be especially adapted for life in the tissues where they reproduce by fission. Encystment does not take place in the tissues, but only in the lumen of the gut. Cysts are usually passed only in association with formed or semiformed stools. They may remain viable in feces at room temperature for at least 2 weeks and may persist in water for a month or more. Cysts withstand freezing for a year, but a tempera-

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ture of 55° C. kills them in a few minutes. They are highly susceptible to drying which kills them almost instantly. Both trophozoites and cysts are briefly described in paragraph 5.

3. TRANSMISSION. Amebic infection is acquired by the ingestion of food or drink contaminated by feces containing amebic cysts. So-called carriers or infected individuals who, at the time, do not have diarrheal or dysenteric stools are the principal source. Infected rats and other animals may be sources of human infection, but their role in the natural spread of the disease is not considered important. Under some circumstances, such as unhygienic crowding, transmission from man to man may be direct. Usually the disease is transmitted indirectly. The most important means of spread is by the contamination of food and drink by those who handle it during its preparation, serving, or at any time before it is consumed. In extensive areas, especially Mediterranean, Middle Eastern, and Far Eastern regions, truck gardens are fertilized with raw human feces which often contain viable cysts. Vegetables grown under such conditions, unless they are thoroughly cooked, may be a dangerous source of infection. Flies and other insects, including cockroaches, by spreading cysts through direct contact or in their feces, may contaminate food or drink. Contamination of the water supply with infected feces is a frequent means of spread. Swimming or wading in contaminated water might be a means of acquiring amebic infection, but this does not seem to be a dangerous possibility.

4. COURSE. *a. General.* The severity of amebic infection is extremely variable. Many individuals who are infected never have symptoms which can be attributed to the disease with certainty. Some observers attribute relatively vague symptoms to the disease, such as lassitude, anorexia, indigestion, and abdominal discomfort, in cases in which these are the only disturbances present, but the significance of the association between such symptoms and amebic infection is uncertain. On account of the more or less ever present possibility of reinfection, the duration of amebic infections in the absence of clinical manifestations is not known with certainty. However, infections with *E. histolytica* may persist for many years.

b. Intestinal infection. Any part of the colon, and rarely the terminal portion of the ileum, may be affected. In some instances, lesions are limited to the cecal region. The appendix is occasionally involved. The earliest lesion is a small abscess, usually in the submucosa. Later, ulcers form which, as seen after death, tend to be ragged, undermined, and large. When symptoms develop, they may appear as soon as 8 to 11 days after infection, but usually the interval is longer, sometimes many months. As a rule, the onset is insidious. In the absence of treatment, the course is usually long drawn out, often with many remissions and relapses. It is an error to suppose that amebic intestinal infection must cause severe dysenteric symptoms, since in many cases only mild, though persistent, disturbances occur. The principal symptoms in mild cases are diarrhea (often without gross blood, pus, or mucus in the stools) and abdominal pain and tenderness. Fever and leukocytosis are absent. Diligent search of the stools demonstrates motile amebae in many such cases. In severe cases, the classical picture of dysentery may appear suddenly or it may grow gradually out of the mild condition just mentioned. The symptoms include headache, nausea, griping abdominal pain, abdominal tenderness, and fever. Urticarial lesions have been described in some groups of patients. Increased frequency of bowel movements and tenesmus occur in varying degrees. The stools are described in paragraph 5*b*(1). Clinical attacks may last only 5 or 6 days or they may continue, with or without remissions, for months. In some cases, periods of constipation alternate with those of diarrhea. When chronic infection is fully established, the intestine is profoundly altered, showing extensive ulceration and gross thickening. Secondary infection of the lesions is inevitable in such cases. The process may give rise to extensive adhesions or to peritonitis which may be either localized or generalized. Perforation of the intestine is an occasional event in both acute and chronic stages. Patients with chronic amebic dysentery are often emaciated.

c. Hepatitis and hepatic abscess. Involvement of the liver arises from intestinal infection. The exact frequency of amebic hepatitis and hepatic abscess is not known, but these

conditions are not rarities. Although the majority of patients with proved amebic liver disease give a history of dysentery, about a third of them do not. Hepatic disease usually appears 1 to 3 months after an attack of dysentery, but it may manifest itself directly in association with an attack or only many months or years later. Post mortem examinations in cases without a history of dysentery sometimes show intestinal ulcers. Diarrhea or dysentery is actually present in only about a fourth of the cases of proved liver disease. Diffuse amebic hepatitis may be an early stage of abscess formation. Abscesses are usually located in the right lobe of the liver and single, but abscesses in the left lobe and multiple abscesses are not rare. Abscesses develop insidiously, although the onset of symptoms may be abrupt. When diagnosed, they are often huge. The symptoms include pain or discomfort over the liver, with occasional reference to the right shoulder, irregular and intermittent fever, sweats, chills, nausea, vomiting, weakness, and loss of weight. Jaundice, except in mild degree, is unusual. The results of physical and laboratory examinations are mentioned in paragraph 5*b*(3). Secondary infection of amebic abscesses is unusual, but when present it has an important bearing on treatment and prognosis. Liver abscesses may rupture in any direction and into any neighboring organ. The common directions are into the pleura and lung, peritoneum, and pericardium. External rupture, which is unusual, may take place through the abdominal wall or through the right lumbar region.

d. Other lesions. In rare instances, the lungs, brain, and other organs are infected by hematogenous spread from the intestines. Lesions of the skin are occasionally infected with amebae, especially in the region of the perineum and buttocks and especially in association with traumatic and postoperative wounds.

5. DIAGNOSIS. *a. Terminology.* According to Medical Department usage, cases of amebiasis with intestinal symptoms and abnormal stools which contain motile amebae should be diagnosed "Dysentery, amebic." It should be noted that this diagnosis includes mild cases as well as cases with the fully developed classical picture of dysentery. Such diagnoses should be reported on WD AGO Form No. 8–122 (Statistical Health Report) (formerly WD, MD Form 86 ab); no other entries for amebic infections should be made on this form. Cases in which there are no symptoms and cysts alone are found in the stools should be diagnosed "Carrier of *Endamoeba histolytica*." "Hepatitis, amebic" and "Abscess, liver, amebic" are acceptable terms for the indicated conditions.

b. Clinical diagnosis. The possibility of amebic infection should be brought to mind by the clinical picture (see par. 4) and by epidemiologic consideration. The final diagnosis should be based on the demonstration of the etiologic agent.

(1) Amebic dysentery must be differentiated from other forms of protozoal dysentery, bacillary dysentery, mucous colitis, intestinal tuberculosis, and schistosomiasis. Bacillary rather than amebic dysentery should be suspected when there is sudden and fulminating onset with prostration and bloody stools. Mild cases of cholera should not be mistaken for amebic dysentery. Confusion arises occasionally between appendicitis and amebic infection. Lymphogranuloma venereum (lymphogranuloma inguinale or lymphopathia venerea) involving the rectum may simulate amebic infection. In these cases, digital examination discloses a characteristic firm nodular condition. Inspection of the stools is helpful, since the results can be used, if necessary, as a basis for a tentative diagnosis. The stools of amebic dysentery are relatively less frequent, less watery, less purulent, and more fecal than those of bacillary dysentery. They are characteristically colored by flecks of both fresh and altered blood and contain characteristically tenacious mucus which is not intimately mixed with the blood. In chronic cases, the stools are especially malodorous.

(2) In suitable cases in which stool examinations have failed to be diagnostic, proctoscopy following a saline enema is a valuable aid, since lesions are often readily visible. It should be performed by, or under the supervision of, an experienced medical officer. As commonly seen through a proctoscope, amebic ulcers do not appear to be deep, ragged, or undermined, and may not suggest to the inexperienced observer the presence of serious disease. Pin-point

mucosal areas which are raised and hemorrhagic should be noted, since they often overlie small amebic abscesses. They may be good sources of material containing motile amebae. While the proctoscope is in place, material for examination should be obtained through the instrument from any lesion which may be in sight. A cotton applicator of sufficient length is often used. A more successful method employs a heavy walled 1 cc serological pipette with an outside diameter of 6 to 7 mm. The delivery end of the pipette is bent to an angle of about 45° and inserted into a rubber bulb from a urethral syringe. The pipette is inserted through the proctoscope and with gentle suction created by the rubber bulb is applied to a lesion. The specimen is ejected onto a slide by compression of the bulb.

(3) Amebic infections of the liver must be separated from other forms of hepatitis, including abscesses due to bacterial infection. The diagnosis of diffuse amebic hepatitis can only be suspected on clinical grounds. Fever, local pain, and tenderness, together with enlargement of the liver, are usually the only findings. If evidence of hepatitis persists after 5 or 6 days of treatment as described in paragraph 6*c*, the presence of an abscess should be suspected. When an abscess is present, the liver is usually enlarged and tender, but in some cases it is not palpable. Tenderness may be demonstrable by bimanual compression of the lower right chest wall. However, since tenderness may be well localized, it should be searched for with care. Signs of involvement of the diaphragm, pleura, or lung may be found. X-ray studies are exceedingly helpful. A moderate leukocytosis is usually present, but there is no eosinophilia. Amebae can be demonstrated in the stools of about a third of the cases. Liver abscesses contain a thick, semifluid material composed of more or less cytolyzed remains of tissue. This material often, but not always, has a dark reddish-brown or chocolate color. Motile amebae are found in it in about a third of the cases, depending largely on the part of the abscess from which the material has been derived (they may be entirely absent in the central area, where cytolysis is complete). Cysts are not present.

c. Routine laboratory studies. The blood may show leukocytosis of moderate degree. Eosinophilia does not occur, unless some other infection is present. The presence or absence of anemia is not helpful in diagnosis. An increased erythrocyte sedimentation rate has been reported, especially in patients diagnosed as having amebic hepatitis. The urine is not remarkable. The gross appearance of stools has been described in paragraph 5*b*(1), above. Their microscopic appearance is important. In comparison with the findings in bacillary dysentery, leukocytes, and macrophages are relatively scarce. Red blood cells are numerous in certain portions. Charcot-Leyden crystals may be present. The search for, and identification of, amebae is described in the paragraphs below. Smears should be made of material from hepatic and other abscesses, and examined for bacteria.

d. Specimens to be searched for amebae. (1) Motile forms of *Endamoeba histolytica* may be found in diarrheic and dysenteric stools, in exudates from lesions, and in abscess contents. Amebic infection should never be considered to be excluded as the result of a single examination. Search for motile amebae should only be made in freshly obtained material (for technique, see TM 8–227). Examination of specimens that have stood about for any length of time either in the ward or in the laboratory is not only a waste of time, but gives misleading negative results. On the other hand, motile amebae are often killed by overzealous warming of a slide. In some cases, especially those in which cecal infection without involvement of the lower colon or rectum is suspected, it may be necessary to give a saline cathartic in order to obtain a satisfactory specimen. Blood stained flecks of mucus in the stool are likely specimens for examination. In some instances, a good specimen can be obtained in the eye of a rectal tube. With suitable precautions, excellent material can often be obtained through a proctoscope, as described in paragraph 5*b*(2), above. When liver abscesses is suspected, material for examination may be obtained by aspiration, with the precautions mentioned in paragraph 6*b*.

(2) Cysts of *Endamoeba histolytica* should be sought in formed and semiformed stools. They may sometimes be found even in the more fecal portions of dysenteric specimens. When

stools are formed, examination of freshly passed specimens is preferable, but not essential, provided the specimen remains moist. Since a single examination detects only about 50 percent of cyst carriers, at least three specimens obtained on different days should be examined. Concentration by zinc sulfate flotation is the most certain method for finding cysts (for technique, see TM 8-227).

(3) Stool specimens obtained following an oily cathartic or a barium meal are unsatisfactory for examination. Another specimen should be collected after 48 to 72 hours.

e. Identification of amebae. (1) Identification of *Endamoeba histolytica* should be attempted only by trained personnel. Motile and encysted forms must be distinguished from other species of protozoa which are commonly found in human feces. Large mononuclear cells, vegetable organisms (such as *Blastocystis hominis*), and artifacts, are frequently identified by error as *Endamoeba histolytica.*

(2) Motile forms of *Endamoeba histolytica*, which are usually 20 to 40 microns in size, characteristically show active progressive locomotion and often contain red blood cells, the presence of which is confirmatory of the identification. Other inclusions, such as bacteria and debris, are infrequent. The clear ectoplasm is sharply differentiated from the homogeneous granular endoplasm and the blade-like pseudopodia are formed explosively. The nucleus is usually not visible in the living ameba, a point which together with the active locomotion, readily distinguishes *E. histolytica* from mononuclear blood cells. Precystic forms are smaller than ordinary trophozoites; they do not contain red blood cells and are practically nonmotile. It is particularly difficult to distinguish this stage of *E. histolytica* from nonpathogenic species.

(3) Cysts of *Endamoeba histolytica* are typically spherical, measuring 6 to 20 microns in size (average about 12 microns). The four nuclei present in mature cysts are visible only after staining (with iodine in fresh preparations, or hematoxylin in fixed smears). Large bar-shaped refractile chromatoid bodies with rounded ends may sometimes be seen in unstained cysts. When present, they serve immediately to differentiate cysts of *E. histolytica* from those of other amebae.

f. Cultures. Methods for growing *E. histolytica* from specimens may be of value when properly carried out. As a rule, however, direct methods of examination suffice to establish the diagnosis of clinical cases. Cultural methods have their greatest use in surveys to detect carriers. Material from an abscess should be cultured for bacteria which may be present.

g. Complement fixation. Tests have been described which are specific, but difficulties in preparing the antigen preclude general use of this test in Army laboratories.

6. TREATMENT. *a. General.* Patients with symptomatic amebic infection should be kept in bed, unless the symptoms are very mild (confinement to bed is indicated, if diarrhea, hepatitis, or hepatic abscess is present). The diet and fluid intake should be controlled as indicated below. In convalescence, all patients should gradually take a liberal building-up diet, supplemented by four multivitamin tablets a day. No single drug can be relied on to cure all patients with amebic infection. It is necessary, therefore, to use a combination of remedies. Penicillin and sulfonamides are ineffectual in amebiasis as such. They may be important adjuncts, however, in the treatment of cases in which secondary bacterial infection is present. The use of drugs to stop diarrhea in amebiasis, such as bismuth and opiates, should be restricted to instances in which it is considered imperative. Free or injudicious use of such drugs interferes with the chemotherapy of amebiasis. In general, cathartics and laxatives are not indicated and may be harmful.

b. Acute or chronic amebic dysentery. In acute cases, the diet should be liquid until symptoms subside and then soft with low residue, until convalescence is established. In chronic cases, the diet should be soft until the patient is convalescent. If signs of hepatitis or hepatic abscess are present, treatment should be given as described in *c*, below. The recommended antiamebic treatment includes three drugs. The administration of carbarsone and either diodoquin or chiniofon in addition to emetine is considered essential.

(1) Emetine hydrochloride is given subcutaneously or intramuscularly in doses for adults not to exceed 0.03 gm (½ grain) twice a day, or 0.06 gm (1 grain) once a day, during the period of diarrhea, but not for more than 4 to

6 days. Patients should be confined to bed while receiving emetine and for a few days thereafter. A course should not be repeated until 2 weeks have elapsed. Emetine should not be given to patients who have no symptoms or only very mild symptoms or to patients with heart disease. The toxic effects include nausea, vomiting, muscular weakness, neuritis, myocarditis (manifested by increased pulse rate or decreased blood pressure), and prostration. If available, electrocardiograms are helpful in following the toxic action of the drug. If any toxic sign appears, the administration of the drug should be stopped at once. Concurrently with the administration of emetine, carbarsone is given as described in (2) below.

(2) Carbarsone is given by mouth in doses of 0.25 gm (3¾ grains) three times a day for 7 days. It should not be given to patients with hepatic disease. Toxic symptoms, which are rare, include abdominal distress, diarrhea, nausea, and vomiting; very rarely, exfoliative dermatitis, and possibly visual disturbances may occur. Carbarsone is followed by diodoquin or chiniofon. If for any reason carbarsone is omitted, diodoquin may be administered concurrently with emetine.

(3) Diodoquin is given by mouth in doses of 0.63 gm or 9.6 grains (3 tablets of 0.21 gm or 3.2 grains each) three times a day for 7 days. No significant toxic symptoms have been reported.

(4) As an alternative to diodoquin, chiniofon may be given by mouth in doses of 1 gm (15 grains) three times a day for 7 days. The only toxic symptom commonly encountered is watery diarrhea.

(5) In some refractory cases, especially those in which ulcers are visible on proctoscopic examination, carbarsone or chiniofon should be given by enema, following a cleansing enema of water. Retention may be aided by the use of a mild sedative. Carbarsone 2 gm (30 grains) is dissolved in 200 cc of 2 percent sodium bicarbonate solution (carbarsone is insoluble in water). Chiniofon 4 gm (60 grains) is dissolved in 200 cc of sterile water. (Emetine and diodoquin cannot be given by enema.) Such enemas are given every night for 5 nights. If there is irritation, the frequency of enemas should be reduced to alternate nights.

(6) In refractory cases, bacterial infection may be present. In such instances, the use of penicillin or sulfadiazine is recommended.

c. Amebic hepatitis, hepatic abscess, and other metastatic lesions. Intestinal infection is usually present also. If the patient has dysentery, the diet should be as described in *b* above, otherwise, it should be soft until convalescence is established. The recommended treatment includes emetine and diodoquin or chiniofon. Carbarsone should not be given to patients with hepatic disease.

(1) Emetine hydrochloride is given as described in *b* (1) above, but continued for 8 days, provided no toxic symptoms appear. Emetine is followed by diodoquin or chiniofon.

(2) Diodoquin is given for 7 days, as described in *b*(3) above.

(3) As an alternative to diodoquin, chiniofon may be given for 7 days, as described in *b*(4) above.

(4) If hepatic abscess is present, the abscess should be drained by aspiration after 2 to 4 days of treatment with emetine. However, when the size and location of the abscess suggest that rupture is imminent, aspiration should be performed at once and treatment with emetine instituted at the same time. The site of aspiration should be carefully selected in accordance with the physical findings. The operation should be performed with scrupulous technique in an operating room. Open drainage should not be performed, unless it is demonstrated by smear or culture that the abscess is secondarily infected. Repeated aspiration may be necessary. In instances of secondary infection with susceptible organisms, the use of penicillin or sulfadiazine is recommended.

d. Amebic infections without symptoms or with only mild enteric symptoms. During treatment the diet should be soft; physical activity should be limited. The recommended treatment consists of carbarsone as described in *b*(2) above, followed by diodoquin as described in *b*(3), or chiniofon as described in *b*(4) above.

e. Follow-up. The results of treatment should be checked by means of repeated clinical and laboratory examinations. When encysted or motile amebae persist or are rediscovered, a further course of treatment should be given after a suitable interval. Symptomatic relapses should be treated vigorously, provided the pres-

ence of motile amebae is demonstrated. It should be noted, however, that the administration of antiamebic drugs is sometimes followed by diarrhea which may be persistent. Such diarrhea may not be the result of continued amebic infection. Courses of chemotherapy should not be repeated merely because of simple diarrhea when amebae are not demonstrated. The repetition on many occasions of courses of emetine without adequate use of other chemotherapeutic agents is especially undesirable. Patients should not be disposed of or released from medical supervision until three examinations have been negative, at least one of which should be obtained following a saline cathartic. It is desirable, when possible, to recheck patients by an examination about 1 month after completion of treatment, but patients should not be held in hospital for this purpose.

7. PROGNOSIS. The eradication of amebic infection is sometimes difficult, but it is nearly always possible with persistent appropriate treatment. When patients remain in highly endemic areas, the possibility of reinfection must be borne in mind. In acute dysentery, the response to prompt, well directed treatment is generally excellent, especially as regards symptoms. Under good management, uncomplicated hepatic abscesses rarely should be fatal. Old, well established chronic intestinal infections following repeated acute attacks, secondarily infected liver abscesses, and other metastatic lesions, especially brain abscesses, may be refractory to treatment and are dangerous to life.

8. PREVENTION. The prevention of amebic infection in military forces consists essentially in supervision of personal hygiene of mess personnel, the detection and adequate treatment of food handlers, the protection of food and drink from flies and other pest insects, the proper purification of water supplies, the sanitary disposal of human excreta, and the avoidance of eating uncooked fruits and vegetables which may be contaminated.

a. Food handlers. When facilities are available, stool examinations for *E. histolytica* should be made on personnel prior to their assignment as food handlers. Routine stool examination of mess personnel, using zinc sulfate concentration technique, to detect amebic carriers should be made at intervals of 6 months. In highly endemic areas, examination of food handlers at monthly intervals is recommended. Infected individuals must not be permitted to handle food until three negative stool examinations have been obtained following treatment. Native help should be excluded as food handlers at military installations. Personal hygiene, especially the proper cleansing of hands, must be emphasized and rigidly supervised for personnel preparing and serving food.

b. Food. Eating establishments located outside of military establishments which fail to meet sanitary standards in the procurement and serving of food should be declared out of bounds. In tropical or subtropical areas, fresh fruits and vegetables should be washed thoroughly and cooked before being served, or else treated with solutions of chemicals issued by the Quartermaster for this specific purpose. Sources of fresh vegetables should be supervised to prevent the use of human excreta as fertilizer.

c. Water. In the field, drinking water can be made safe only by special methods of chemical treatment or filtration, or by boiling. If an adequately filtered or treated water supply is not available, drinking water should be boiled and then chlorinated. Troops should be particularly cautioned not to drink water from untreated sources. As soon as practicable after occupation of a new area, wells should be drilled and maximum use made of subsurface water.

(1) For chemical treatment, a concentration of chlorine sufficient to give two parts per million residual after 30 minutes contact is required to destroy cysts of *Endamoeba histolytica.* When using canteens, two halazone tablets are sufficient to kill cysts, unless the water is turbid or colored, in which case four tablets should be used. It is important that 30 minutes contact will be allowed before the water is consumed. When using Lyster bags and calcium hypochlorite (grade A), the water will be treated to provide one part per million of residual chlorine after 10 minutes contact. An additional ampule of calcium hypochlorite will then be added and the water allowed to stand for 30 minutes more before use.

(2) In filtration to remove amebic cysts, certain precautions are necessary in the operation of standard portable water purification units. Pretreatment should include the application of

at least three parts per million of chlorine, a coagulent dosage of alum sufficient to give a heavy rapidly settling floc, and a minimum settling period of an hour. Filter output should be restricted to not more than 10 gallons per minute for portable units and to not more than 60 gallons per minute for mobile units. The recently standardized diatomaceous earth filter is highly efficient in removing amebic cysts, but pretreatment should always be used when the water is turbid or muddy. After any type of filtration, the water should show a chlorine residual of one part per million after 30 minutes contact. If this has not been accomplished by prechlorination, more chlorine should be added.

d. Control of flies. (1) Sanitary disposal should be made of human excreta to prevent fly breeding (see AR 40–205, AR 40–210, and FM 21–10). In the field it is essential that flies be denied access to human feces by flyproof construction of latrines. Where native labor is employed, proper latrine facilities should be provided and their use enforced. Kitchen and mess halls should be adequately screened. Destruction of adult flies with insecticides, traps and fly swatters should be practiced routinely, especially in mess halls and latrines.

(2) DDT residual spray (5 percent DDT in kerosene, QM Stock No. 51–I–305) applied to surfaces on which flies commonly rest will remain lethal to flies lighting on such surfaces for 2 or more months. The spray should be applied at the rate of 200 mg per square foot (1 quart per 250 square feet). Screens, walls, ceilings, light fixtures, and garbage racks should be treated. Pit latrines, also, should be treated by spraying the walls of the pit, the inside and outside of the latrine box, and the walls and screens of the inclosure. To control fly breeding in pit latrines, it is recommended that DDT residual spray be applied evenly over the contents at the rate of 2 ounces per latrine box hole (½ ounce per square foot); or, 1 ounce of 10 percent DDT powder (larvicide, DDT powder, dusting, QM Stock No. 51–L–122) may be used (¼ ounce per square foot). This treatment should be repeated twice a week, unless local experience indicates that less frequent application will suffice.

[AG 300.5 (30 Apr 45)]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL
Chief of Staff

OFFICIAL:
J. A. ULIO
Major General
The Adjutant General

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Refer to FM 21–6 for explanation of distribution formula.

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